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The seagrass fish fauna of Geographe Bay, Western Australia

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Abstract

Samples of the fish fauna inhabiting the seagrass beds (*Posidonia* spp.) of Geographe Bay, Western Australia, collected by a small beam trawl, are dominated by the odacid *Neoodax radiatus* (662 of 1265 individuals). Eighteen other species occur, including one new record for Western Australia. Five of the species are represented by less than 6 individuals. Flora and invertebrate fauna from the seagrass beds were found in the guts of most of the fishes.

Introduction

Seagrasses of various species form large meadows in embayments around the south-west of Australia (Cambridge 1975). They are thought to be important breeding grounds (Hoese 1978; Kikuchi and Peres 1977) and serve as an important source of food for certain fishes (Brook 1977; Carr and Adams 1973; Kikuchi and Peres 1977).

The fish fauna of seagrass beds have been described for some eastern Australian localities by Conacher (1977), Hoese (1978), Hutchings and Recher (1975) and Shepherd (1974), but not for Western Australia. This paper describes the fish fauna of the seagrass beds of Geographe Bay, Western Australia.

Geographe Bay (33°S, 115°E) constitutes the coastline from Bunbury to Cape Naturaliste. Twelve locations between Capel Beach and Quindalup were examined (Fig. 1). The seagrass beds were in water

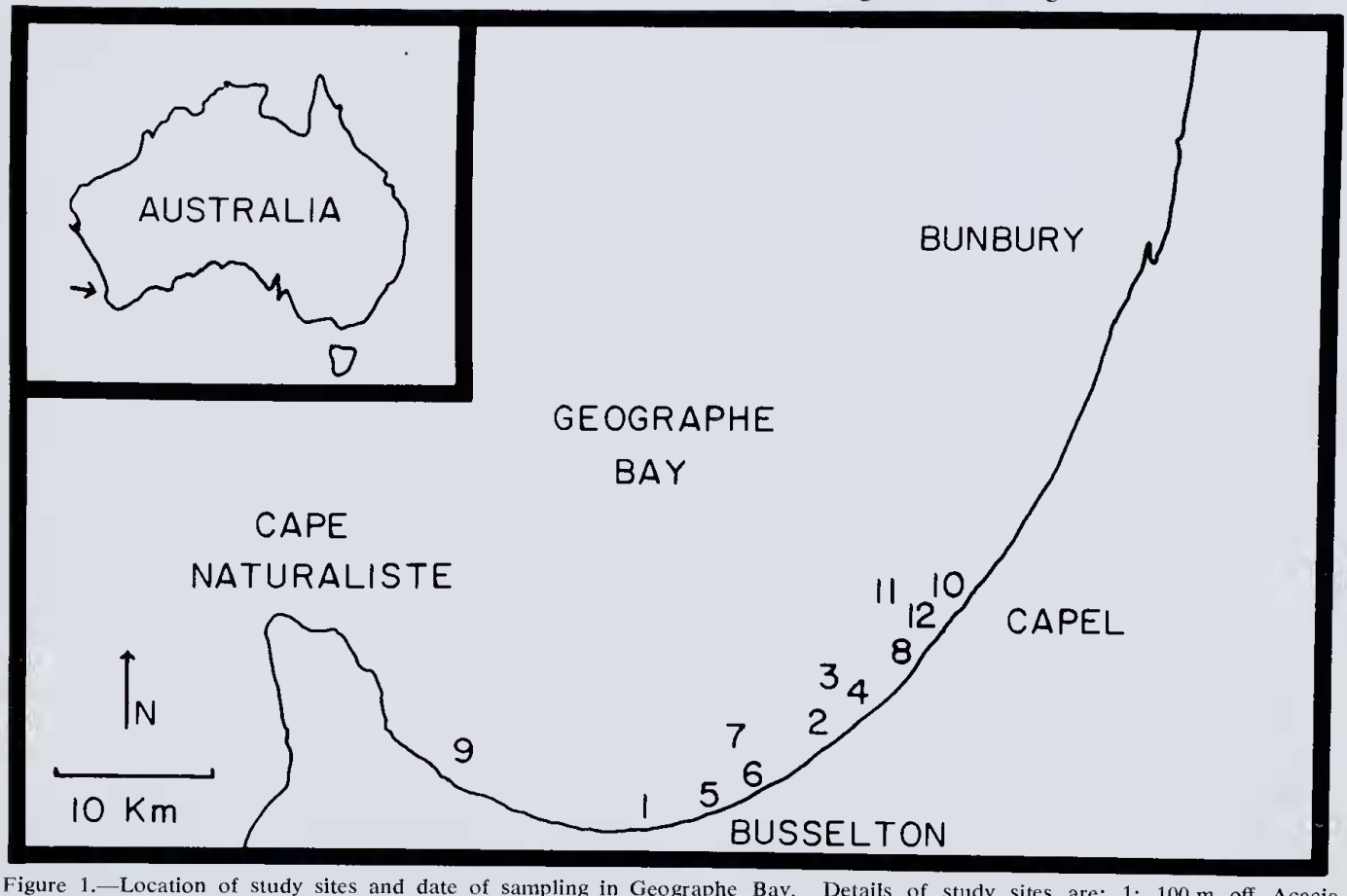

Figure 1.—Location of study sites and date of sampling in Geographe Bay. Details of study sites are: 1: 100 m off Acacia Caravan Park, 5 m deep, 26 Dec 1972; 2: 800 m off Wonnerup Beach, 5.5 m deep, 30 Dec 1972; 3A: 800 m off Wonnerup Estuary, 7 m deep, 3 Jan 1973; 3B: 800 m off Wonnerup Estuary, 7 m deep, 25 April 1975; 3C: 800 m off Wonnerup Estuary, 7 m deep, 25 Dec 1977; 4: 200 m off Wonnerup Estuary, 5 m deep, 3 Jan 1973; 5: 800 m offshore, west of Busselton Jetty, 5 m deep, 4 Jan 1973; 6: 800 m offshore, east of Busselton Jetty, 4.5 m deep, 5 Jan 1973; 7: 1000 m offshore, east of Busselton Jetty, 7 m deep, 5 Jan 1973; 8: 200 m offshore, half-way between Wonnerup and Forrest Beaches, 5 m deep, 13 Jan 1973; 9: 100 m off Quindalup Beach, 5 m deep, 14 Jan 1973; 10: 100 m off Forrest Beach, 5 m deep, 28 Jan 1973; 11: 800 m off Forrest Beach, 5 m deep, 2 Feb 1973; 12: 100m offshore, west of Forrest Beach, 6 m deep, 2 Feb 1973. All distances offshore are approximate.

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depths ranging from 4.5 m to 7.0 m and consisted entirely of *Posidonia* spp. except for sites 10 and 12 which included some *Amphibolis antarctica* (Labill.) Sonder et Aschers. Geographe Bay has at least 3 species of *Posidonia*, but the beds examined consist predominantly of an undescribed member of this genus (Cambridge, pers. comm.).

Methods and results

Samples were taken by beam trawl, mouth dimensions 88 cm by 36 cm. The net was made of 1.5 mm mesh. The trawl was lowered onto the seagrass bed and towed by a small motor boat. The distances towed were between 30 and 50 m with a duration of 1 to 2 minutes. All trawls were in summer, during daylight and a number of trawls were made at each location.

A location was deemed to have been sampled adequately if by repeated samples no additional fishes were added to the total number of species. Figure 2 gives an example of the species-sample curve for site 3C.

The fishes were sorted from the algae and seagrass and either preserved in 10% formalin for gut analysis or taken back to the laboratory alive for observations on behaviour.

Stomach contents were examined under a binocular microscope and items identified as far as possible. The standard length of the fish was measured and various food items scored as present or absent. Identification of food items was aided by examining the invertebrates which were also collected by the trawl. The results of the gut analysis are included in the annotated list of fish species below.

The species abundance data are presented in Table 1. A total of 1265 specimens were collected, comprising 19 species, however, the community is clearly dominated by *Neoodax radiatus* as 662 or 52.3% of the fish belong to this species. It is only displaced from dominance of all sample locations by the presence of abundant small juveniles of *Apogon rueppellii* and *Acanthaluteres spilomelanurus*.

Representative specimens of fishes were deposited with the Western Australian Museum and the catalogue numbers are given in Table 2. The minimum and maximum lengths in Table 2 are based on standard length measurements of both museum speci-

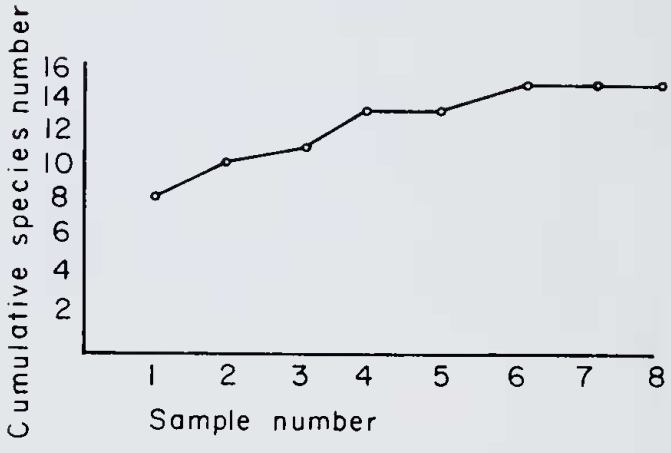

Figure 2.—The cumulative species number for consecutive samples taken from study site 3C.

Table 1

Numbers of individuals of each species caught at each sampling locality. Localities are shown in Figure 1.

Species	Locality														
	1	2	3A	4	5	6	7	8	9	10	11	12	3B	3C	Total
Aspasminae sp. 1	3	1	1	2	2		1	1	3					5	19
Aspasminae sp. 2		1		1		3	1		3					5	14
Aspasminae sp. 3														4	4
S. argus	4	5	7	5	1	4		4	4	9	17	1	4	17	82
S. poecilolaemus					1		1							2	4
G. marmoratus				1			1							4	6
A. rueppellii									80	2				68	150
S. cephalotes			1	2	1	5	1	1						2	13
P. aurantiacus	4	35	4	11			15	5		7	2	4			87
N. radiatus	81	98	32	49	36	26	61	53	14	40	25	56	29	62	662
N. semifasciatus		1							3	10				12	26
C. australis	7	7		1		1		1		1				3	21
H. adelaidae		4		2			5	6		2			1	1	21
A. haackeanus		1													1
A. spilomelanurus	21	6	3	2	2	4	6	1	4	1	3	3		59	115
S. granulatus	1	6	11		1		2	2		2	2			1	28
B. jacksonianus			1		1			1		1	3	1		3	11
M. freycineti												1			1
A. nicthemerus										1					1

Table 2

The size range (mm) and the catalogue numbers of the specimens deposited in the Western Australian Museum.

Species	Length Range (mm)	W.A. Museum catalogue numbers
Aspasminae sp. 1	23–40	WAM P26455–013, WAM P21336, WAM P21337, WAM P25466–001, WAM P21572–75
Aspasminae sp. 2	4–11	WAM P26455–012, WAM P25466–002
Aspasminae sp. 3	4–11	WAM P26455–011
S. argus	16–235	WAM P26455–001, WAM P21011–19, WAM P25259–001
S. poecilolaemus	108–205	WAM P26455–002, WAM P21010
C. marmoratus	44–56	WAM P26455–003, WAM P22596
A. rueppellii	5–45	WAM P25259–003, WAM P26455–014
S. cephalotes	13–32	WAM P25259–005, WAM P26455–009, WAM P21091–72
P. aurantiacus	16–70	WAM P26456, WAM P21563–70
N. radiatus	10–141	WAM P25259–001, WAM P20926–33, WAM P20926–36, WAM P26455–004, WAM P21020, WAM P21553–4
N. semifasciatus	11–38	WAM P26455–005, WAM P21009
C. australis	20–104	WAM P21040, WAM P26455–010
H. adelaidae	14–50	WAM P26455–015, WAM P21041, WAM P25259–004
A. haackeanus	94	WAM P22597
A. spilomelanurus	5–70	WAM P21039, WAM P26455–008, WAM P25334 001
S. granulatus	23–68	WAM P25336–001, WAM P26455–006, WAM P21036
B. jacksonianus	13–21	WAM P26455–007, WAM P21582–83
M. freycineti	75	WAM P26456–002
A. nicthemerus	28	WAM P21551

mens and samples used for gut analysis and indicates the size range of specimens trawled from the seagrass.

The arrangement of the families in the annotated list below, follows that of Greenwood *et al.*, (1966).

Annotated species list

Order Gobiesociformes

Gobiesocidae—Clingfishes

Aspasminae sp. 1

This clingfish is a member of a new genus and species (Briggs, pers. comm.). The salient features include a rectangular snout, body greatly compressed dorso-ventrally, gill membranes free from the isthmus, no opercular spine, and a large sucker in two parts. Counts were as follows: dorsal rays 4-6, anal rays, 5-7, pectoral rays 15-20, ventral rays 4, and caudal rays 10. Colour of adults in preservative was yellow-brown. Colour when alive was green or brown. It appears to be restricted to the seagrass, but its habits are not known.

Aspasminae sp. 2

This clingfish also represents a new genus and species (Briggs, pers. comm.) It can be distinguished from the above species by its smaller size and pointed snout. It is greatly compressed dorso-ventrally with gill membranes united posteriorly with the isthmus, operculum with a strong spine and a large sucker in two parts. Counts were as follows: dorsal rays 3, anal rays 2, pectoral rays 17-18, ventral rays 4 and caudal rays 10. Colour of adults in preservative was uniformly yellow-brown. Colour when alive was green or brown. It lays 6 to 12 eggs on the surface of the seagrass and the parents remain with the eggs. This species is found in slightly shallower water than the previous species. The feeding habits are not known.

Aspasminae sp. 3

This unidentified clingfish can be separated from the above species by its rounded snout. It also has a body greatly compressed dorso-ventrally, gill membranes free from the isthmus, no opercular spine and a large sucker in two parts. Colour of preserved specimens is uniform yellow. Colour when alive was yellow-green with longitudinal rows of small blue dots, and other blue dots between. Its habits are not known.

All the above clingfish adhere to blades of seagrass by means of their ventral sucker. These species have not been found elsewhere and are most likely restricted to seagrass beds.

Order Gasterosteiformes

Syngnathidae—Pipefishes

Stigmatophora argus (Richardson)

Syngnathus argus Richardson, *Proc. Zool. Soc. Lond.* 8: 29 (1840); type locality, not given.

This was the most numerous species of pipefish found in the seagrass. The gut contents of 12 specimens between 185 mm and 235 mm in length, consisted entirely of copepods. *S. argus* is widely distributed around Australia, Indonesia, Melanesia and Fiji.

Syngnathus poecilolaemus Peters

Syngnathus poecilolaemus Peters, *Monatsb. Akad. Wiss. Berlin*, 1868, p. 548 (1869); type locality, Adelaide, South Australia.

The gut contents of one 205 mm specimen contained filamentous algae while that of a 224 mm specimen contained crustaceans. This species is found in southern Western Australia and South Australia.

Order Scorpaeniformes

Scorpaenidae—Scorpion Fishes

Gymnapistes marmoratus (Cuvier)

Apistus marmoratus Cuvier, *Histoire naturelle des poissons*, 4; 416 (1829); type locality, 'Timor'. (probably Western Australia).

Only juveniles were found in seagrass beds. The guts of 2 specimens, 54 mm and 52 mm in length, contained shrimps, amphipods, isopods and copepods. This species was rare despite having a southern Australian distribution. Grant (1972) has published on the biology of *G. marmoratus* based on samples from Tasmania. He found it associated with the seagrass *Zostera* sp., with reproduction initiated at 2 years and spawning in August and September. Grant's work indicated that shrimps and crabs are the major food items with other fish species being consumed by larger individuals.

Order Perciformes

Apogonidae—Cardinal Fishes

Apogon rueppellii Gunther

Apogon rueppellii Gunther, *Catalogue of the Fishes in the British Museum* 1: 236 (1859); type locality, Victoria.

The large number of specimens caught at stations 9 and 3C were all juveniles, having a length less than 2 cm. The guts of 7 specimens were found to contain amphipods, isopods, and copepods. This fish is found on all Australian coasts.

Siphamia cephalotes (Castelnau)

Scopelus (Neoscopelus) cephalotes Castelnau, *Res. Fish. Aust.* 1875, p. 46 (1875); type locality, Adelaide.

Most specimens were juveniles, one fish, 25 mm in length contained a shrimp in its gut. This species is found in all Australian states except Queensland.

Labridae—Wrasses

Pseudolabrus aurantiacus (Castelnau)

Cheilinus aurantiacus Castelnau, *Proc. Zool. Acclim. Soc. Vic.* 1: 245 (1872); type locality, St. Vincents Gulf, South Australia.

Five specimens were measured and examined for gut contents. The results were: 60 mm, *Posidonia* leaf, foraminifers and amphipods; 67 mm, algae, shrimps, amphipods; 70 mm, molluscs, shrimp and foraminifers; 45 mm, *Posidonia* leaf, molluscs, isopods and shrimp. *Posidonia* leaf and algae do not appear to form a major part of the diet. *P. aurantiacus* is found in South Australia and Western Australia.

Odacidae—Weed Whitings

Neoodax radiatus (Quoy and Gaimard)

Malacanthus radiatus Quoy and Gaimard, *Voyage de decouvertes de l'Astrolabe*. Zoologie. 3: 717 (1835); type locality, King George Sound, Western Australia.

This was the most common fish in the seagrass beds of Geographe Bay and with other species of *Neoodax*, it is restricted to this seagrass habitat (Scott 1976). The gut contents of 37 specimens were examined and the results are summarised in Table 3. Adults are thought to spawn from August through to December and by January, small juveniles are found. *N. radiatus* is distributed from Western Australia and South Australia to Tasmania.

Table 3

The percentage of each food item, and the percentage of fish containing the food item for 37 Neoodax radiatus. *The size range of the fish was* 41 *mm to* 141 *mm with a mean ± standard error of* 91·1 ± 3·77.

Food item	% of total food items	% of fish with food items
algae	3·7	13·5
Posidonia leaf	5·9	21·6
Amphibolis leaf	0·7	2·7
foraminifers	11·0	40·5
bivalves	2·2	8·1
trochid gastropods	8·1	29·7
unidentifiable molluscs	21·3	78·4
amphipods	7·4	27·0
copepods	1·5	5·4
isopods	9·6	35·1
shrimps	15·4	56·8
unidentifiable crustaceans	11·8	43·2
pycnogonid	0·7	2·7
sand	0·7	2·7

Neoodax semifasciatus (Valenciennes)

Odax semifasciatus Valenciennes, *Histoire naturelle de poissons* 14: 299 (1839); type locality, Indian Ocean.

Four specimens were measured and examined for gut contents, the results being: 32 mm, copepods; 38 mm and 34 mm, copepods and foraminifers; 30 mm, copepods, foraminifers and *Posidonia* leaf. This species was the most common fish observed by Shepherd (1974) in the seagrass beds of Upper Spencer Gulf, South Australia, but in this survey it was caught infrequently and all specimens were juveniles. *N. semifasciatus* has a southern Australian distribution.

Clinidae—Weedfishes

Cristiceps australis Valenciennes

Cristiceps australis Valenciennes, *Histoire naturelle des poissons*, 11: 402 (1836); type locality, Tasmania.

This species was present both as adults and juveniles throughout the sampling area. It is ovoviviparous and is presumed to spawn in the seagrass. Milward (1967) discussed the biology of the clinid fishes of Western Australia and considered this species to be mainly restricted to the seagrass habitat. Milward (1967) states that it consumes fish and crustaceans. I have observed it to eat live fish in aquaria and the guts of 2 specimens, 48 mm and 104 mm, contained shrimps and a crab respectively. *C.australis* has a southern Australian to New Zealand distribution.

Heteroclinus adelaidae Castelnau

Heteroclinus adelaidae Castelnau, *Proc. Zool. Acclim. Soc. Vict.* 26: 68 (1873); type locality, Adelaide, South Australia.

This species also appears to be associated with seagrass beds (Hoese 1976). It is probably ovoviviparous and completes its life cycle in the grassbeds. One specimen, 48 mm in length, had shrimp in its gut. *H. adelaidea* has a southern Australian distribution.

Order Pleuronectiformes

Soleidae—Soles

Aseraggodes haackeanus haackeanus (Steindachner)

Solea (Achirus) haackeana Steindachner, *Anz. Akad. Wiss. Wein.* 20: 95 (1883); type locality, South Australia.

This was probably an accidental inclusion in the trawl as soles normally inhabit sandy bottoms. It is found in South Australia and is a new record for Western Australia.

Order Tetraodontiformes

Monacanthidae—Leatherjackets

Acanthaluteres spilomelanurus (Quoy and Gaimard)

Balistes spilomelanurus Quoy and Gaimard, *Voyage autour du monde . . . sur l'Uranie et la Physicienne . . . Zoologie*: 217 (1824); type locality, Port Jackson, New South Wales.

This leatherjacket only appears in the grass beds as juveniles. Six individuals were measured and examined for gut contents. The results were: 61 mm, algae and foraminifers; 56 mm, algae and unidentifiable calcareous pieces; 63 mm, algae, unidentifiable calcareous pieces and molluscs; 52 mm, green algae and crustaceans; 49 mm and 48 mm, algae and unidentifiable calcareous pieces. *A. spilomelanurus* has a southern Australian distribution.

Brachaluteres jacksonianus (Quoy and Gaimard)

Balistes jacksonianus Quoy and Gaimard, *Voyage autour du monde . . . sur l'Uranie et la Physicienne . . . Zoologie* 209: (1824); type locality Sydney, New South Wales.

Two specimens were examined for gut contents. One, 21 mm in length, contained an unidentifiable white material while the other, 19 mm in length, contained algae, eggs and mollusc shells. *B. jacksonianus* has a southern Australian distribution.

Meushenia freycineti (Quoy and Gaimard)

Balistes freycineti Quoy and Gaimard, *Voyage autour du monde . . . sur l'Uranie et la Physicienne . . . Zoologie*: 213 (1824); type locality, Mauritius.

The gut of a 75 mm specimen contained algae. *M. freycineti* has a southern Australian distribution.

Scobinichthys granulatus (Shaw)

Balistes granulata Shaw, *White's voy. New South Wales:* 295 (1790); type locality, New South Wales.

This leatherjacket only appears in the grassbeds as juveniles. Four individuals were measured and examined for gut contents. The results were: 68 mm, algae, eggs, foraminifers, serpulid polychaetes, and molluscs; 50 mm, *Posidonia* leaf, algae, and polychaete tubes; 36 mm, *Posidonia* leaf, algae, foraminifers and shrimp; 28 mm, *Posidonia* leaf, algae, foraminifers and sand. Specimens from the seagrass are unable to capture live shrimp (*Macrobrachium* sp.) in aquaria. However, *Neoodax radiatus* is able to bite off the eyestalks of the shrimp, thus allowing the leatherjackets to devour it. *S. granulatus* has a southern Australian distribution.

Diodontidae—Porcupine Fishes

Atopomycterus nicthemerus (Cuvier)

Diodon nicthemerus Cuvier, *Mem. Mus. d'Hist. Nat. Paris* 4: 135 (1818); type locality 'Mers des Indes' (probably Tasmania).

Only one juvenile was collected. *A. nicthemerus* is found in Western Australia, South Australia, and Tasmania.

Discussion

The only fishes in the seagrass that could be regarded as commercially important are three leatherjackets, *Acanthaluteres spilomelanurus, Meushenia freycineti* and *Scobinichthys granulatus.* However, it is possible that the beam trawl fails to capture species which live just above the grassbeds and use the seagrass and its fauna as a food source. Zei (1962) who used a similar type of trawl in the seagrass, *Posidonia oceanica,* comments on the likelihood of missing species by only trawling during the day. This shortcoming may have also affected the present study and the nocturnal composition of the seagrass beds will be determined by future sampling.

The majority of fish from *P. oceanica* communities complete their lifecycles in the seagrass (Zei 1962) and this would appear to be the case for the species from the *P. australis* habitat in Geographe Bay. The only numerous group for which adults were not caught was the monacanthids.

Neoodax radiatus was dominant in collections from all but two locations, contrary to studies from other parts of Australia (Conacher 1977, Hoese 1978, Hutchings and Recher 1974, Shepherd 1974), which did not report this species. Other species showing an occasional abundance (*Apogon rueppellii* and *Acanthaluteres spilomelanurus*) were present mainly as small juveniles.

The preliminary examination of the gut contents indicates that most of the fish are carnivorous and that their food source is entirely derived from the seagrass beds.

The only species endemic to southern Western Australia are the three undescribed clingfishes but it is expected that their range will be extended with further work on other seagrass beds. Most of the species have southern Australian distributions. Only *S. argus, C. australis* and *M. freycineti* have been recorded outside Australia.

The Syngnathidae, Scorpaenidae and the Labridae are families found in other fish communities from grass beds around the world (Kikuchi and Peres 1977). The seagrass fish community from Geographe Bay differs by the dominance of the Odacidae, which is endemic to the Australian-New Zealand region. More detailed work in the future is planned to investigate seasonality and to give more details on the use of space, time and food and the possible interactions between species.

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